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Public Health 192 (2021) 30–32

Contents lists available at ScienceDirect

Public Health

journal homepage: www.elsevier.com/locate/puhe

Short Communication

Cohabitation COVID-19 transmission rates in a United States suburban community: A retrospective study of familial infections

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ARTICLE INFO

Article history:
Received 17 September 2020
Received in revised form
10 December 2020
Accepted 5 January 2021
Available online 16 January 2021

Keywords:
COVID-19
SARS-CoV-2
Public health surveillance
Viral transmission
Cohabitation infections
Suburban
Transmission rates
Household transmission

ABSTRACT

Objectives: SARS-CoV-2 is a highly contagious virus that causes coronavirus disease 2019 (COVID-19) and can affect people of any age with potential for serious symptoms. Since the start of the COVID-19 pandemic, global infection rates have been on the rise with world leaders looking to slow and stop viral transmission. This study is looking at suburban cohabitation/familial infection to compare to similar studies from other countries.

Study design: A retrospective review of medical records was collected using the Connecticut Electronic Disease Surveillance System.

Methods: A total of 406 cases who tested positive for SARS-COV-2 from February to June 2020 were reviewed from three towns located in Connecticut, USA. Cohabitation infection rates were identified using the home addresses of those with confirmed SARS-CoV-2 test results, with the first documented case being the index case, and additional home members being the secondary cases.

Results: Secondary transmission of SARS-CoV-2 developed in 126 of 406 household contacts (31%). Linear regression indicated positive relationship between cohabitation and age.

Conclusions: The cohabitation infection attack rate of SARS-CoV-2 is significantly higher than previously reported. Age of household contacts and spousal relationship to the index case are risk factors for transmission of SARS-CoV-2 within a household.

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Introduction

The novel coronavirus SARS-CoV-2, the highly transmissible virus that causes coronavirus disease 2019 (COVID-19), was first detected in the United States in early 2020. As of August 20, 2020, the world has over 22.2 million cases and 782,456 deaths with the USA making up over 5.4 million cases and 170,640 deaths.[1] COVID-19 can cause acute respiratory distress syndrome, leading to respiratory failure. Early projections of this contagious virus reported a basic reproductive rate (R0) around 3.28 with a median of 2.79, which exceeded the World Health Organization (WHO) estimates from 1.4 to 2.5.[2] Italy observed large spikes of fatalities early in the pandemic. Italy's early elevation in COVID-19 cases is believed to be due to its older population, as 23.3% of Italians are aged over 65 years, as well as its common practice of intergenerational cohabitation between adult children and parents.[3]

Several studies from China have also researched the topic of cohabitation infections from the index, or primary infected, case. One study from Wuhan reviewed 392 household contacts and reported 16.3% having infections from the primary case living in the same home.[4] In the study, those who quarantined themselves at the start of symptoms, while following appropriate isolation recommendations, reduced their secondary attack rate to zero.[4] A retrospective cohort study in Guangzhou identified a secondary attack rate of 17.1% using address-based review.[5] A third retrospective study based in Shenzhen identified a group of 391 infected cases with 1286 close contacts and had a secondary attack rate between 11% and 15%.[6]

Given the limited published cohabitation transmission rates in China and Italy, and the limited data produced in the USA, it was felt that additional studies were needed. The Westport Weston Health District (WWHD) hypothesized that among three suburban towns, the cohabitation transmission rates would be equal to or lower than those reported in larger cities in China. The purpose of the study is

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https://doi.org/10.1016/j.puhe.2021.01.003
0033-3506/Published by Elsevier Ltd on behalf of The Royal Society for Public Health.

to examine three small towns in Connecticut to investigate the household infection rates and compare with the 11–17% range of cohabitation infection rates seen in other countries.

Methods

Location

The WWHD is a local, non-profit, health district for Westport, Weston, and Easton Connecticut, USA, that is overseen by a board of directors and the Connecticut's Department of Public Health. The WWHD performs contact tracing, serves as a test site, and conducts educational open forums to reduce COVID-19 in the community. The clinic within the WWHD is overseen by an independently-practicing nurse practitioner and has a team of two nurses and one medical assistant. Outside of COVID-19 public health tasks, the clinic treats non-urgent illnesses, visits homeless shelters, provides homebound care, screens patients for communicable diseases, and advises town residents on health topics.

Ascertainment of study participants

A retrospective review of medical records was collected using the Connecticut Electronic Disease Surveillance System (CEDSS), which is used by all Connecticut local health departments for disease monitoring and tracking. Search terms included positive COVID-19 test results, age, gender, address, hospitalization, and deaths for the towns of Weston, Easton, and Westport. Data were collected using the time range from January 1, 2020, to March 29, 2020. Demographic information (name, address, gender, birth date, age, city, state, ethnicity), hospitalization, outcome, and update were extracted from the CEDSS server. Personal health information was removed for analysis. A total of 406 positive cases were reviewed. For the purpose of this study, we used the WHO's definition of cluster infections, which is the following: 'Countries/territories/areas experiencing cases, clustered in time, geographic location and/or by common exposures.'[1] It should be noted that all 406 cases were reviewed after any suspected clustered transmissions based on Department of Public Health's database, as the time frame of positive test results from positive cases indicated a delay in transmission from any initial clustered events. The eligible household defined for cohabitation infection was an address having more than one confirmed COVID-19 case. A confirmed case, or index case, was the first or suspected first person in the home to have contracted COVID-19 and transferred the virus to one or more household members. This retrospective data analysis was performed in accordance with US privacy laws. The research design and ethical considerations were reviewed and approved by the Western Institutional Review Board (WIRB) on July 17, 2020, with exemption under 45 CFR § 46.104(d)(4).

Data analysis

Data were analyzed using SPSS for Windows, Version 26.0 (Chicago, IL). Mean group differences were analyzed using one-way analysis of variance, whereas dichotomous variables (i.e. age, gender, location) were analyzed using Fisher exact or chi-square tests. Strengths of association between variables were examined by Pearson correlation coefficients and by linear regression analyses with generation of odds ratios and accompanying 95% confidence intervals. All statistical tests were two-tailed with an alpha level of 0.05.

Results

As seen in Table 1, the demographic breakdown across three towns were noted. Despite having a majority of the positive cases occurring in Westport, relative percentages for gender, age, and positive cohabitation were in alignment. For each town, the relative rate of positive cohabitation (as defined earlier) varied from 22% to 34% of the total sample. Moreover, the distribution per household ranged from one additional family member to five. Significant differences were noted between the towns in the number of senior living positive infections. In addition, the number of hospitalizations were significant, yet each town was proportionally balanced based on overall total positive cases and total town population.

Uniformly high and strong significant Pearson correlations ranging in magnitude from 0.239 to 0.398 were noticed between positive cohabitation, age, outcome, and hospitalization. No differences were noted between gender or age. A linear regression using positive cohabitation as the dependent variable predicted hospitalizations, age, city, and gender ($F = 5.619$, $df = 4, 290$, $P < .001$). However, only age was significant predictor of the linear regression (<0.001).

Discussion

The present study hypothesized that among three suburban towns, the cohabitation transmission rates would be equal to or lower than those reported in larger cities in China. Findings identified that these three suburban towns had a cohabitation infection rate ranging from 22% to 34%. This indicates a higher rate of transmission as compared with previous studies and supports guidelines for COVID-19 persons living together.[4–6] The current findings also highlight a high range of transmission with at least two household members infected per each index case, which it is unclear if proper isolation precautions were maintained. The data revealed that cohabitation transmission risk existed among all ages, races, and genders and each of the three towns had similar transmission cohabitation risk. In addition, age was a predictor of the positive cohabitation, thus providing more evidence that COVID-19 does not discriminate between age. As older age increases the risk of medical complications for those infected, younger age may have an increased risk of being an asymptomatic carrier when compared with adults living in the same dwelling. Use of strict isolation guidelines, including separation from household members, may reduce secondary cases. However, further evidence is needed to provide a direct connection between positive cohabitation rates and age.

COVID-19 is a highly infectious virus that can be transmitted via droplet or airborne particles. To reduce the risk of secondary infection, those at risk should follow public health guidance, including appropriate social distancing, proper hand washing, home disinfection, and donning of face coverings and protective equipment.[7] When a person infected with a communicable disease is isolating at home, this places other household members at risk for cohabitation transmission infections. Household infection data analysis allows for a fixed measure to estimate the transmissibility of infections and look for risk factors, such as age.[8,9] Analyzing data from household studies can help prioritize COVID-19 control measures, education on identification and isolation of the infected, and social distancing.[9] Cohabitation infection transmission is just one population risk factor that is being evaluated to potentially reduce the transmission of COVID-19.

There were several limitations of the current manuscript. First, the data compiled from the State of Connecticut's Department of Public Health is limited due to ethically contextual variables. This analysis does not include persons with COVID-19 who were not

Table 1
Demographics and cohabitation across suburban towns.

	Weston	Westport	Easton	P-value
Total positive cases	67	305	32	
Gender				0.327
Male	37	147	19	
Female	30	158	13	
Age in years, M (SD)	45.2 (21.5)	50.4 (22)	48.6 (19)	0.202
Positive cohabitation, (%)	23 (34%)	95 (31%)	7 (22%)	0.452
Positive rehabilitation/senior living, (%)	0	47 (15%)	0	<0.001
Hospitalizations	4	28	2	0.002
Outcome				0.657
Passed away	2	23	2	

Note. M = Mean; SD = Standard Deviation.

reported to the state, but this study included confirmed SARS – CoV-2 PCR tested subjects. Secondly, we noted that the familiar COVID-19 transmissions occurred in homes with a living space with an average of 4077 square feet, which is above the state average by 2273 square feet. To provide a more realistic generalization, future research is needed to better understand home sizes equal to and below the state average to understand the relationship of home square footage with COVID-19 cohabitation transmission. As such, a current investigation is being done to better evaluate this.

Author statements

Acknowledgements

The authors would like to thank the Town of Easton's Health department for their support and contributions of data to this study. The authors would also like to thank Loren Pace, RN and the rest of the Westport Weston Health District staff for their dedication and early testing of patients.

Ethical approval

The research design and ethical considerations were reviewed and approved by the Western Institutional Review Board (WIRB) on July 17, 2020 with exemption under 45 CFR § 46.104(d)(4) and abides by the Helsinki code of ethics.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interests

The authors have indicated they have no potential conflicts of interest to disclose.

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